PATENT SPECIFICATION 997,433

DRAWINGS ATTACHED.

Inventors:—WERNER EISERT and GÜNTER KRAUSE.

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COMPLETE SPECIFICATION.

Improved Starting Arrangement for Single-Phase Induction Motors.

We, LICENTIA PATENT-VERWALTUNGS-G.m.b.H., a German Company having its registered office at Theodor-Stern-Kai 1, Frankfurt (Main), Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to single-phase induction motors of the split-phase kind, and aims at ensuring a reliable and chatter-free disconnection of an auxiliary starting capacitor in the split-phase when the current traversing a parallel connected main phase-shifting capacitor and a series connected split-phase winding of the motor attains a predetermined value.

Accordingly this invention resides in a starting arrangement for split-phase induction motors having a circuit, comprising a coil in series with a capacitor, connected in parallel with another circuit, comprising an auxiliary starting capacitor in series with a contact pair, the two circuits being connected in series with a split-phase winding of the motor, and the contact pair being controlled by the coil to interrupt when the current in the coil attains a predetermined magnitude.

More details will become apparent from the following description referring to the accompanying drawings, in which:

Fig. 1 shows a circuit arrangement embodying the invention,

Fig. 2 shows a graph with reference to which the operation of the invention will be explained, and

Fig. 3 shows a preferred construction of a detail.

Referring to Fig. 1 the stator of a single-phase induction motor, which is not shown for the sake of simplicity, carries a main winding *Ha*. A switch S controls the connection of the motor through terminals O, P to a single-phase supply circuit. A series circuit comprising a split-phase winding *Hi*, a phase shifting capacitor KB and a coil R of a relay for instance is connected in parallel to the main winding *Ha*.

A series circuit comprising an auxiliary phase-shift capacitor KA for the motor start and a pair of contacts RK controlled by the coil R is connected in parallel to the coil R and capacitor KB. Coil R opens the contacts RK when its energising current derived from and proportionate to the current traversing the winding *Hi*, exceeds a predetermined value which indicates that the motor has run up and the additional phase shifting capacitor KA is no longer needed.

Fig. 2 shows the change of current I*Hi* which traverses the winding *Hi* and determines the energisation of coil R, in dependence upon the rotational speed *n* of the motor.

When switch S is closed to start the motor, contacts RK are closed. The current in the main winding *Ha* decreases as the rotational speed of the motor increases, while the current traversing the auxiliary winding *Hi* and coil R increases along portion 1 of the curve shown in Fig. 2. At the point 2 of the curve the induction motor attains a required torque and speed, and at this instant the current in the coil becomes sufficient to open the contacts RK. When relay contacts RK open the additional phase shift capacitor KA is disconnected, and the current through winding *Hi* increases suddenly to the point 3 of Fig. 2. Thereafter the current increases gradually to a normal "running" value as indicated by portion 4 of the curve of Fig. 2.

While the motor is running contacts RK remain open, but close again when the motor

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is disconnected by switch S. The circulating current through the capacitors KA, KB occurring when relay contacts RK close, is limited by the high impedance of the relay coil R.

The sudden current increase from point 2 to point 3 of Fig. 2 ensures that the relay contacts remain open even if a fluctuation occurs in the supply voltage. Another advantage is that the relay contact is already closed, and need not be closed by the effect of current flowing through a motor winding when control switch S is closed.

The relay R may be of any suitable construction as is generally available. However, in a construction according to Fig. 3 as preferred, the contact gap is enclosed in a housing 5 which preferably comprises two identical halves joined together along an axial plane of the housing. L-shaped terminals 6, 7 are kept in place by slots in the top of the housing through which the vertical portions of the terminals project. The horizontal terminal portions constitute stationary contacts and a contact bridge 9 is provided to open when a relay coil 8 is energised. Contact pressure is exerted by the weight of an armature 10 through a compression spring 11 interconnecting the bridge 9 and armature 10. The armature 10 is of piston shape and is slidable along a sleeve 12 held on a centre pin 13. The ends of pin 13 are held in recesses of the bottom and top of the housing 5. The ends of sleeve 12 are turned outwardly to form flanges and the lower flange is situated below the underside of the bridge 9. A ferromagnetic core member 14 of cylindrical shape is adjustably movable parallel to the armature movement and along the pin 13, and is accommodated in a cylindrical projection of the housing top, which itself is surrounded by the relay coil 8. When coil 8 is energised and armature 10 is initially attracted contact bridge 9 is held in the closed position while coiled spring 11 expands. However, when the top of armature 10 hits the flange at the upper end of sleeve 12 the contact bridge 9 is suddenly lifted off the stationary contacts 6, 7 by the sleeve. Spring 11 also prevents vibrations and clatter of the contact 9 due to current fluctuations. As the armature 10 is attracted towards coil 8 the flux path to the core 14 is shortened and the armature force increases to ensure forceful and sudden contact opening.

The ratio between the current values at which the relay contact RK is opened and closed can be set by adjusting the position of the core 14. In a practical embodiment the current value for attraction of the armature can be four times the current value at which the armature is dropped.

Modifications are possible without departing from the scope of the invention as defined by the appended claims. Means as are known in the art may be used for adjusting the position of core 14 without opening the relay housing.

WHAT WE CLAIM IS:—

1. A starting arrangement for split-phase induction motors having a circuit, comprising a coil in series with a capacitor, connected in parallel with another circuit, comprising an auxiliary starting capacitor in series with a contact pair, the two circuits being connected in series with a split-phase winding of the motor, and the contact pair being controlled by the coil to interrupt when the current in the coil attains a predetermined magnitude.

2. An arrangement as claimed in claim 1, including a movable armature and a spring, the spring continuing to exert contact pressure during an initial period of armature movement due to attraction by the coil, and the armature causing sudden contact break by impact upon an intermediate member at the end of said period.

3. An arrangement as claimed in claim 2, wherein the coil has a ferromagnetic core, whose position is adjustable in relation to the armature and coil.

4. An arrangement as claimed in claim 3, wherein the movement of the armature and adjustment of the core are parallel to each other.

5. An arrangement as claimed in claim 4, wherein the armature, spring and core are enclosed in a two-part housing which is joined in an axial plane thereof, the coil surrounds a cylindrical projection of the housing, and the core is situated in said projection.

6. A starting arrangement for split-phase induction motors substantially as herein before described with reference to the accompanying drawings.

J. W. RIDDING,
Chartered Patent Agent,
33, Grosvenor Place,
London, S.W.1,
Agent for the Applicants.

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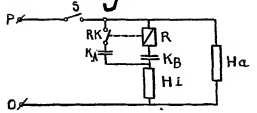
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

Fig. 1.



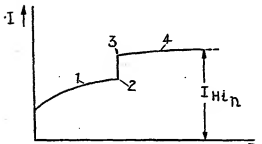


Fig. 2.

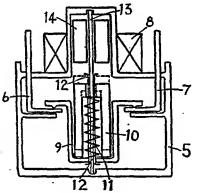


Fig. 3.